

leaves. In the dried material the leaves have 'scorched' spots or areas, spotted with black dots and surrounded by dark brown borders.

EUGENIA CARYOPHYLLATA, Thunb. (*Myrtaceae*). The Clove.

Irpex flavus, a yellow "toothed" fungus (*Hydnaceae*) is reported by Bancroft as causing a root disease. Ridley states that a red-spotting leaf fungus, probably a member of the *Peronosporaceae*, was responsible for abandoning the clove cultivation about 1860.

EUGENIA GRANDIS, Wt. (*Myrtaceae*). Jambu Ayer Laut.

Valsaria cinnamomi (*Sphaeriaceae*) on dead bark, collected by Baker at Singapore. The fructifications of the fungus appear as dark brown or black eruptions through fissures of the bark.

T. F. CHIPP.

(To be continued).

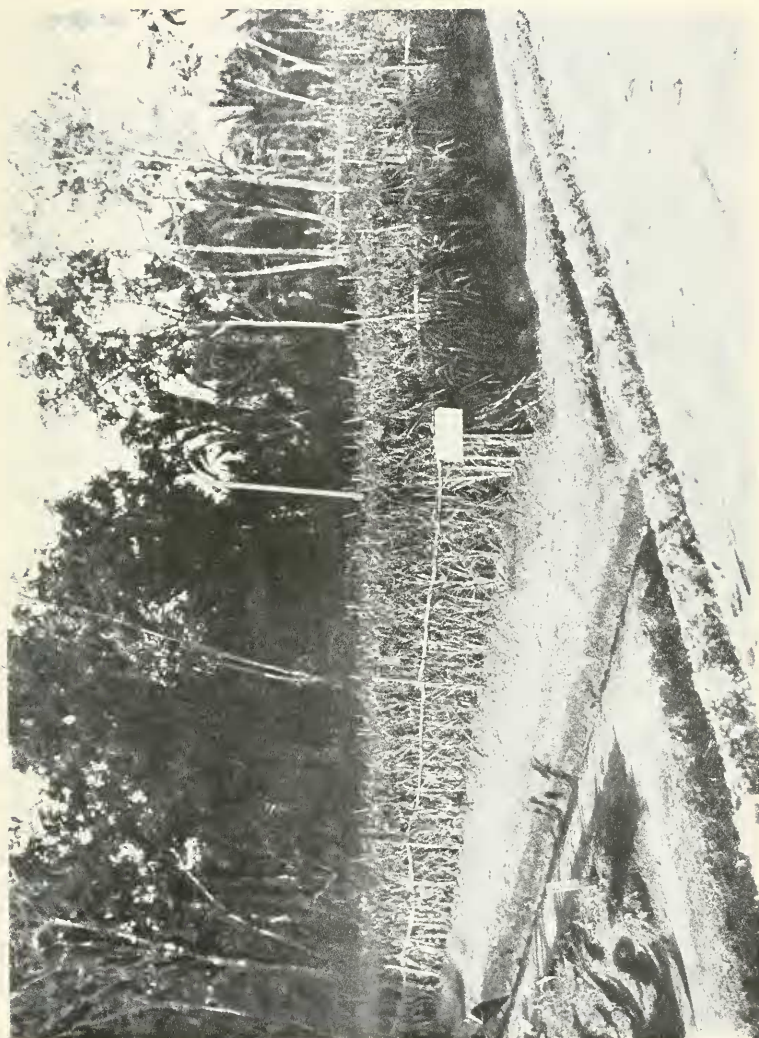
Some Trials of Food Plants in the Economic Gardens II.

Lima Beans (*Phaseolus lunatus*).

The Lima Beans, Small Siéva Pole, originally received from the firm of A. H. Dreer, Philadelphia, U. S. A., and which were reported upon at length in the Garden's Bulletin of 4th July 1919, have been kept under cultivation continually in the Economic Gardens since July 1918. It was shown, by the records of seed gathered up to, and inclusive of the fourth generation, that the crops had been well maintained and that the beans had not degenerated in weight, size or quality.

But the results since obtained do not confirm this; they in fact have disappointed the writer's expectations. It is not, however, yet time to ascribe the falling off in the subsequent crops to actual degeneration in the seed, for, in recent weighings taken in October 1919, it was found that the weight of the beans was well maintained, and the percentage of germinations on a plot of 1056 plants, sown on 28th October, the last of the season, was as high as 96 per cent. At the time of writing (22nd November) this plot shows the most vigorous and healthy growth, a fact which would exclude any tendency to degeneration.

To explain the discrepancy between this last statement and the disappointing results of the crop as a whole, it is necessary to refer to the locality where the trials were made. The area planted in Lima beans was a little over two acres consisting (all but a small part of 4000 square feet, or one eleventh of an acre) of a low strip of land skirting a hill, and made of drift soil, either washed from



Ragi, Eleusine Coracana.

the hill side, or brought by the floods which frequently occur. It is therefore of an alluvial character, of good depth and of a fine loamy texture, the very best medium one would think for a trial of this nature: actually however, it was not at all suitable.

To begin with, it had been for years under a rank, semi-aquatic vegetation of wild grasses and of *Pandanus* (Screw-pine), with a few stunted Rubber trees. The large sago-palms growing near-by, mark the land for what it really is namely an undrained, almost undrainable swamp: its structure, a peaty bottom overlaid with the rich silt brought by floods. Such is the land with the exception of the small plot of $\frac{1}{11}$ of an acre referred to above, a gentle slope at the foot hill, well above flood level. Here is no drift or alluvial soil but the ordinary coarse yellow sandy clay, characteristic of Singapore hill-sides. This small plot had been for some years under cultivation and sundry annual crops had been raised off it in 1917 by Professor Baker (see Gardens Bulletin July 4th 1918). Now, it is off this small plot of rather poor and thin material, that the crops of Lima beans were grown by the writer, the results of which were given in the Bulletin of 4th July 1919, and on it are still to be seen beds of Lima beans of healthy growth, with abundant crops on them. One bed, in particular, sown on 31st July 1918, shows at date of writing, quite a fair crop of young pods. What, then, is the explanation of the unsatisfactory return of the *ensemble* of the crop? How is it that the promising results previously obtained, as shown in Bulletin No. 4 of 1919, now fail?

In the writer's opinion, this failure is due to the host of diseases brought about by fungi and insect pests which are bound, in the natural course of things, sooner or later to attack and destroy plants grown under adverse conditions in an uncongenial soil. And here, for the sake of clearness, one may be permitted a slight digression. In some countries, Burmah for instance, we hear of the Lima bean being grown on alluvial deposits formed along the river banks, by the silt of periodical inundations, a condition resembling somewhat that under which the Economic Gardens are placed. But there is this difference between the case of periodical seasonal floods and the case of occasional floods which last only a few hours over undrained land. In the one case, the parasitic fauna and flora is killed by the prolonged sojourn of the waters on the land, moreover the steady withdrawal of the river water to a much lower level as the floods subside, allows of perfect drainage of the alluvial deposit left on the land. Thus a perfectly new soil is formed, perfect in nutritive elements for plant life, perfect in physical texture, and above all, a soil purged of fungoid and insect pests—a clean soil which, with a minimum of tillage, will bear such wonderful crops of tobacco and indigo as one sees, for instance, on the banks of the Mekong.

In the other case, new soil is brought on the land, carrying with it seeds of parasitic vegetation and spores of new fungi which find a congenial home in the rank vegetation, a vegetation which thrives all the more for a short immersion, and as the land drains

itself badly and slowly, the cleansing action of the withdrawal of the flood water is lost—result: a sloppy, acid land, infested with pests of every description—a foul land. That is precisely what this land is, which is now dealt with. A foul land, no matter how great its wealth of nutrient material, cannot be fit for intensive cultivation except after a period of repeated tillage and, even then, if the surrounding land is allowed to remain foul, the harvests will be precarious. It is said by people who know the country well, that it is very difficult to rear good dependable garden crops in the rich lowlands of the East Coast of Sumatra, because of the peristent attacks of pests; and this is explained by the fact that so much of the land, after the tobacco crops have been harvested, is allowed to revert to rank vegetation over which parasitic life runs riot.

"This digression will serve to explain the failure of the Lima bean crop in the Economic Gardens to come up to expectations. The failure of a crop, however, does not necessarily imply the degeneration of the seed; but certain figures of weighings taken by the writer at different periods bear on this point and they are here given.

A. One handful of beans of the third generation put on one side of the scale numbered 55 beans: one handful of beans of the fourth generation put on the other side tilted the scale with 56 beans.

B. 100 seeds taken from a parcel of Lima bean seed received from the firm of A. H. Dreer, Philadelphia, on 19th June, 1919, were put on one side of the scale and it took 120 of our local selected seed, after one month's drying to tilt the scale. (The local seed were the offspring of seeds received from the same firm the year before).

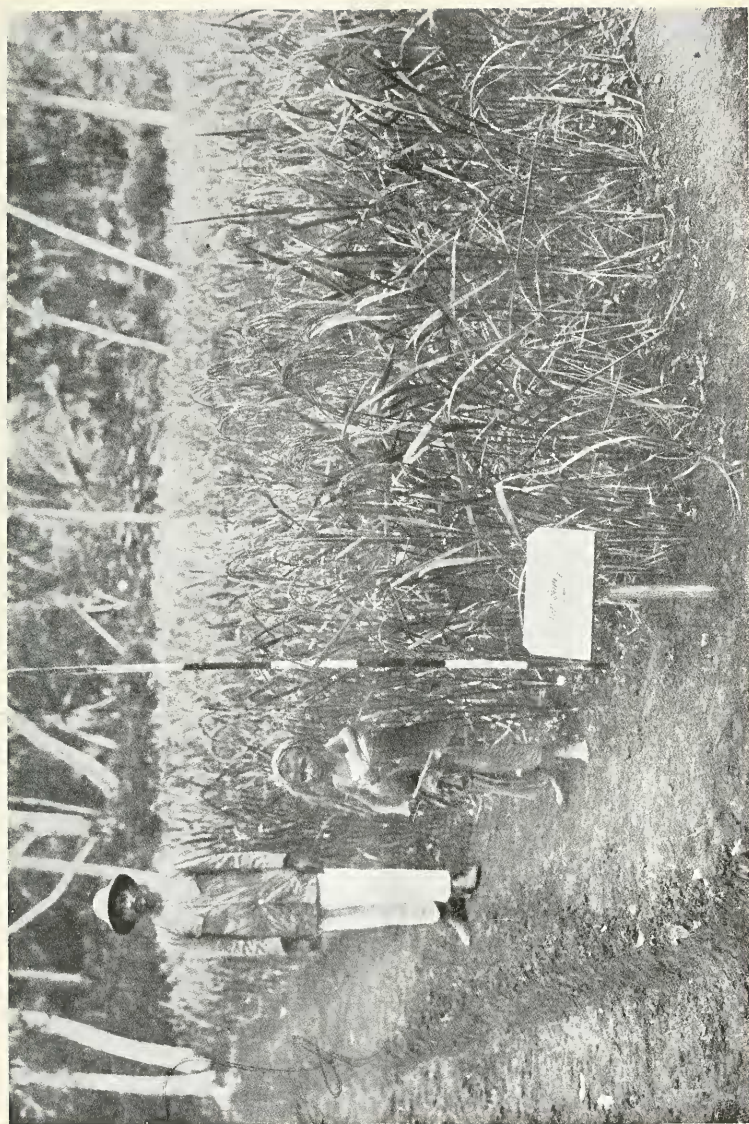
C. One pound of beans picked on 23rd May 1919, and kept to dry for 8 days contained 916 beans, whereas,

D. one pound of beans picked on 20th-October, (*i.e.* the following generation) and kept to dry for 12 days contained 1103 beans.

E. One pound of beans selected for sowing in October, contained, after one month drying, 910 beans.

As will be perceived, while some of these figures point to a decided falling-off of the beans in weight as shown in B and by comparing C and D, others, A, and a comparison between C and E do not point to the same conclusion.

In B, however, we have clear evidence, (several weighings were made with much the same results) that the local bean, after nearly twelve months cultivation in the Economic Gardens, has lost 20 per cent of its weight. Is that fact to be taken as a proof that the Lima Bean cannot establish itself in this country without degeneration? It must be remembered that the seeds sent out by the great seedsmen of Europe and America have been evolved by severe selection through successive generations under trained observers to produce a type of bean in this case suitable to a set of local conditions which may, or may not, be reproducible elsewhere,



Hill Paddy, Sown on 20th July, gathered on 10th December.

or only partially reproducible. The chances are that, in their ensemble, they are not reproducible, for the factors which enter into play are many, *e.g.* heat, moisture, constitution of the soil, pollinating insect life, and processes of cultivation are among the factors that work for divergences, and that affect the behaviour of the plant under altered conditions. There is, then, nothing surprising in the fact that the Lima bean, in its transfer from a temperate and relatively dry climate to a tropical and moist one, should suffer a decline from the parent seed. The question is whether, under successive generations of cultivation, the decline is continuous. If this were so, it would, of course, imply progressive degeneracy in the seed and the inadaptability of the Lima bean to our local conditions since reproduction of a seed true to type is the test of adaptability to surrounding conditions—of acclimatisation.

Now tests C and D seem to support the contention that the Lima bean does, in effect, lose in weight from one generation to the next. Here we have 2 lots of beans gathered off the same plot one belonging to one generation containing 916 beans to the pound—the second lot belonging to the following generation containing 1103 beans to the pound that is to say that the latter is 20% lighter than the first.

This may appear to clinch the matter and finally to settle the point of degeneration in the seed. But does it? The writer would be quite prepared to admit it, were it not for the adverse conditions under which the later crops have been reared—conditions which the above digression was meant to make clear.

As can be seen by visitors to the Economic Gardens, the cultivation of the various plots has been as thorough as it is possible to make it in this country and some of the standing crops, ragi, hill paddy, cholam (*Sorghum vulgare*), new to the land and, so far, immune or at least partly so, to the pests that infect the land, show quite adequate returns, birds notwithstanding. But in the sections where bean cultivation has been going on now for several months, the fight is all but hopeless, *Nematodes*, the *Agromyza* fly, *Bruchus rufimans*, also a black bug, round-bodied with shiny carapace, the name of which is not known to the writer, leaf fungi and root fungi have made a set-attack on these plots. Disinfection of seeds, sprayings with Bordeaux mixture and with insecticides, sulphur dustings, petroleum emulsion, neem oil emulsion, have been used without interruption, all with only very partial effect.

Referring again to the tests given above, the figures under A appear to negative the degeneration of the Lima bean from the third generation to the fourth generation: these weights were taken before the various above pests had taken such a hold of the land, but, unfortunately, it was found impossible to carry on these comparative tests with the later crops as the percentage of damaged beans was too great to make the tests of any use.

Test E was made from seeds obtained from the smaller plot previously referred to; but the test is inconclusive from the fact